REMARKS/ARGUMENTS

Under the Office Action mailed July 16, 2003, claims 1-20 were examined. Claims 19 and 20 were allowed, claims 1-4, 6-13 and 15-18 were rejected, and claims 5 and 14 were objected to, but otherwise indicated allowable if rewritten in independent form incorporating all of the limitations of their base and any intervening claims.

Applicant assumes that the new title submitted by way of the amendment mailed on April 24, 2003 was found acceptable since no comment was made to the contrary in this Office Action. Should this not be the case, please advise.

By way of this response, the specification has been amended to further update the status of a previously referenced patent application. Since no new matter is being introduced by way of this amendment, it is respectively requested that it be accepted. In addition, claims 1, 5, 7, 10, and 14 have been amended to provide a more refined definition of the invention, and new claim 21 is being added to obtain for Applicant protection for what is regarded as the invention.

It is respectfully requested that the rejections of claims 1-4, 6-13, and 15-18 be reconsidered and withdrawn for the following reasons.

The Present Invention

The present invention relates to apparatus and methods by which the ***local*** surface characteristics of photolithographic mirrors or the like may be interferometrically measured ***in-situ*** with dynamic interferometers to provide correction signals for enhanced distance and angular measurement accuracy. Mirror surface characterizations or topography along one or multiple datum lines in one or more directions may be made by measuring ***the angular changes in beams reflected off the surfaces during scanning operations to determine local slope and then integrating the slope to arrive at surface topology (emphasis added)***. The mirrors may be mounted in situ on a photolithographic stage or off the stage on a reference frame. As stated in the specification at page 11, lines 26-31:

> "An important feature of the use of single beam interferometers for this application is it contains all spatial frequencies up to the cutoff frequency given by $1/d$, where d is the beam diameter whereas use of a double beam interferometer, such as the HSPMI, would cause loss of all spatial frequencies that have wavelengths equal to the beam spacing of the two double beams or harmonics thereof so the shape could not be recovered."

Thus, "local" as used in the claims means that the invention is capable of measuring mirror properties in situ over the diameter of a single interferometer beam. As a result, mirrors can be characterized over much higher spatial frequencies than is otherwise possible in accordance with the teachings of the prior art.

The 35 U.S.C. 102 Rejections

Under 35 U.S.C. section 102, a claim is anticipated when a single prior art reference discloses each and every element of the claimed invention. Structural Rubber Prods. Co. v. Park Rubber Co., 749 F.2d 707, 715, 223 U.S.P.Q. 1264, 1270 (Fed. Cir. 1984). If the reference fails to suggest even one limitation of the claimed invention, then the claim is not anticipated. Atlas Powder Co. v. E.I. du Pont De Nemours & Co., 750 F.2d 1569, 1574, 224 U.S.P.Q. 409, 41 1 (Fed. Cir. 1984).

Both principal references to Cameron and Tanimoto, et al. used to support the '102 and '103 rejections emphatically do not teach or suggest measuring local mirror characteristics in situ and, indeed, are incapable of this given that both advocate the use of two spaced apart displacement interferometers to measure ***average*** (NOTE: This is not local as with the invention) mirror slope over the distance separating the interferometers.

More particularly, Cameron shows the use of a pair of spaced apart displacement interferometers (X-AXIS 208 and X-θ AXIS 210 and Y-AXIS 216 and Y-θ AXIS 218) to measure average slope between their corresponding spaced apart beams as the X and Y mirror surfaces, 204 and 206, respectively, are scanned. As is explained at col. 5, lines 40 to 50:

> "The total travel distance of stage 200 in the Y direction is sufficient to bring the beams 222 and 224 of X-axis and X-θ axis interferometers 208 and 210, in turn, into cooperative relationship with each successive pairs of points on "X" mirror surface 204 over nearly the entire length of "X"

> mirror surface 204, thereby permitting the "X" mirror surface offset-data value at each of the large plurality of predetermined spaced positions to be independently determined by the computer-controlled servo means."

Clearly, this yields the "average" slope over the distance between successive spacings between the two measurement beams of the Cameron interferometers and does not permit connecting line pairs since there is no intervening slope information between them. But this shortcoming, which Cameron itself recognizes, doesn't appear to be a major concern of Cameron because, at col. 6 lines 22-26, Cameron states that:

> "The reason for this is that experience has shown that the only significant departure from flatness and straightness of either mirror is normally just a slight concave or convex bowing of mirror length about one point of inflection."

In other words, Cameron is not able to measure high spatial frequency variations, i.e., real local effects with his measurement scheme but only low spatial frequency variations, i.e., " . . . slight concave or convex bowing of mirror length about one point of inflection." Apparently, this is good enough for Cameron's accuracy requirements. Consequently, Cameron does not, as the claims require, "compensate for errors in optical path length and errors in beam direction related to the shape of said reflecting surface." Nor, as in claim 21 does Cameron have an interferometer "adapted to direct a measurement beam with a predetermined diameter, d, at the mirror to generate a measurement signal containing information indicative of the relative displacement of said mirror and to generate an information signal indicative of the topography of the mirror and direction of travel of said measurement beam as reflected from said mirror at points where said measurement beam impinges on said mirror after having made only one pass thereto." Consequently, Cameron fails to contain the claimed features of the present invention, and therefore, the '102 rejection based on it should be withdrawn as legally invalid.

The Tanimoto, et al. reference is similarly flawed because Tanimoto, et al. advocates the use of two θ interferometers to provide two parallel measurement beams that are laterally spaced apart from one another by between 5 to 10 mm. Each of these beams measures the displacement to a mirror and the difference in these displacements divided by the distance separating them is a measure of the "local curvature" of the

mirror reflecting surface (See Fig. 5 and Col. 8, lines 10 to 36). However, this local curvature is only an approximation that is made to an accuracy largely restricted by the distance separating the two θ interferometers, which again, fundamentally measure displacement only normal to the surface. Indeed, this is stated mathematically in Equation (2) appearing at Col. 8, line 25 as:

$$\theta Y(x) = Y\theta(x) / SY$$

Tanimoto, et al. itself rightly calls this equation an approximation to the curve angle . And then, Tanimoto, et al. goes on to state, beginning at line 29 of col. 8, that the amount of unevenness, $\Delta Y(x)$, can be obtained through the use of Equation (3). Notice that this also necessarily is an approximation as stated since it, in turn, depends on quantities that themselves are approximations; namely, $\theta Y(x) = y\theta_2 - y\theta_1 / SY$. Consequently, when Tanimoto, et al. refer to the measurement of "local curvature", it really means the curvature as approximated between two displacement measurements that are spaced apart appreciably (5 to 10mm) compared with the angles desired to be measured.

As stated above and in the specification, the present invention uses a single interferometer beam to measure angular changes in beams reflected off surfaces during scanning operations to determine local slope, i.e., the slope over the diameter of the beam, and not two separated beams as in the art. The local slope is then integrated as a function of scan displacement to determine local mirror surface topography along the nominal datum line. As with the prior art, these local measurements can be adjusted to account for stage angular orientation during scanning operations, but all measurements done with the invention are at far higher accuracy than the art since they are done over a much smaller mirror surface area than is the case with the art. Single beam interferometers are preferred then because they can measure pitch, yaw, and displacement with only a single beam to the mirror. Consequently, there can be no question that a continued rejection by Tanimoto, et al. pursuant to '102 would be inappropriate, and it is respectfully requested that the '102 rejections be withdrawn.

As a result of the comments above and the current state of the claims, it is respectfully submitted that neither Cameron nor Tanimoto, et al. meet the legal requirements to sustain a rejection of the foregoing claims under 35 USC 102(b) and that those rejections be withdrawn.

The 35 U.S.C. 103 Rejections

Under 35 U.S.C. section 103, the subject matter of a claim is considered unpatentable when the claimed "subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." The teachings of more than one reference may be considered in combination, but only when there is some teaching or suggestion to support their use in the combination. Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 E2d 281, 293, 227 U.S.P.Q. 657, 664 (Fed. Cir. 1985), *cert. denied,* 475 U.S. 1017 (1986); SmithKline Diagnostics, Inc. v. Helena Lab. Corp., 859 F2d 878,886-87, 8 U.S.EQ.2d 1468, 1475 (Fed. Cir. 1988).

Claims 3, 6, 7, 12, 15 and 16 were rejected under 35 U.S.C. 103(a) as being unpatentable over Cameron or, alternatively, Tanimoto, et al.

For the reasons set forth above, the principal references to Cameron and Tanimoto, et al. fail to meet the factual and legal standards necessary to function as a principal reference in rejecting the base claims from which claims 3, 6, 7, 12, 15 and 16 depend. Since the rejections under '103 rely on the propriety of the Cameron and Tanimoto, et al references in the first instance, they cannot be sustained because both Cameron and Tanimoto, et al. are flawed principal reference for reasons already set forth above. Further, Cameron and Tanimoto, et al.'s use of two spaced apart displacement interferometers actually teach away from the use of dynamic interferometers to measure the angular changes introduced in a single beam after one pass to the mirror to develop compensation signals in situ to correct for local topographical features of stage mirrors. Further, the '103 rejections rely on assertions about how one skilled in the art would have modified the flawed principal references to arrive at the invention set forth in the claims rejected under '103. Clearly, the shortcomings of Cameron and Tanimoto, et al. used in the '102 rejection cannot be repaired so as to operate as a legally valid basis to support the '103 rejection. Consequently, it is respectfully requested that all '103 rejections be withdrawn as well.

In view of the foregoing, Applicant respectfully requests that a timely Notice of Allowance be issued in this application. Should the Examiner have any questions, wish to discuss any aspect of this response, or conduct and interview, please do not hesitate to contact me.

Respectfully submitted,

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Date

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